Altmetrics Attention Score: What is Behind the Numbers?

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Abstract

Today the digital means of communication are evolving rapidly, resulting in more improved and reliable ways of communication. Now the information can be shared or collected instantly, which means the impact through information collection and processing can be faster too. The digital means of research dissemination are enabling people to share their work instantly and gather the attention a lot quicker than the past. The faster means of communication also enabled the researchers to share their scholarly work instantly to extensive and broader addressees. The faster and instant means also empowered to quantify the impact of research works shared or disseminated digitally. Thus, to determining the impact generated by the disseminated academic work over the internet a contemporary or well suited and up to date or alternative approach was required to measure exact or nearly related impact of research outputs disseminated over the web.

The requirements for measurement of the research impact over the web enabled platforms the initiate for the introduction and implementation alternative metrics was started in the last decade. Since its advent, the altmetrics has achieved various milestones regarding the measurement of research impact. The altmetrics is an alternative metric to complement the traditional citation-based approach provided another perspective for the researchers to see the visibility and the impression of research work mentioned or disseminated on web platforms. The altmetrics opened an impressive opportunity for the researchers to determine the impact of their work instantly, alongside the opportunities provided by the altmetrics there are limitations too, which hindered its progress to completely replace the traditional approaches to measure the research impact both qualitatively and quantitatively.

In this thesis study the aim was established to evaluate the altmetrics as a substitutive platform for the quantification and measurement of research influence gathered over the internet. By utilizing literature review approach this study collected most relevant research articles and analysed the collected literature to answer the proposed questions in this thesis study. The results are collected to evaluate the altmetrics as an alternative research impact measuring platform and what does the altmetrics attention score tells us about a disseminated research work. The study found the major opportunities offered by the altmetrics and the limitations for the adaptability of altmetrics as a complete alternative approach. Conclusively, study found that the adoption of altmetrics will take time and the due to existing limitations. The alternative metrics approach or the altmetrics can balance the existing citation-based approaches but can't completely replace them. The altmetric attention score and other indicators provided by altmetrics could be a good early indicator of the research outputs to determine the future impact of disseminated scholarly work.

Keywords: Research dissemination, Altmetrics, Alternative-metrics, Social-media, Article level metrics, Altmetric attention score, Research Impact.

Supervisor

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Foreword

At this moment of life, when I am writing a few words to express my gratitude, I don't want to forget all those people who helped me to read and write from the very beginning of my life when I was not able to read and write. I want to thank all my teachers, peers and folks who helped me to learn and excel throughout my academic life. Apart from all discouraging jokes about thesis work and the efforts it takes to be completed, believe me all those old jokes are for real. It takes a lot of effort to make it through. I'm thankful to my thesis supervisor and a very good teacher, Dr. Arto Lanamäki who really helped me to understand the thesis topic and the time he devoted to guide me from the continuation with the topic till its completion with this thesis submission. Moreover, I thank to all university staff and teachers of information processing science department of the University of Oulu who devoted their time and efforts to teach us. In the end, I thank the University of Oulu and the people of Finland for giving me a chance and the perfect place to learn.

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Terminologies & Abbreviations

Research Impact very generically it can be described as a score or an influence of research outputs gained after the distribution in public regarding to its benefits and effects on human society and for the betterment of human society.

Bibliometrics "Bibliometric methods are frequently used in the analysis field of library and information science". Basically, information management tool statistical analysis of written publications, such as books or articles. (OECD, Frascati Manual 2002, p. 203).

Usage-based metrics is technique in which the valuation of research output is made through the document's download and views counts. Usage-based metrics is a frequently used technique to determine the dissemination influence and attention gained of academic work by applying the usage-based measures or view's and download counters.

Altmetrics is emerging and new technique to determine the information related to disseminated scholarly work through web enabled platforms including news, blogs and social media platforms and publishing websites to quantitatively distribute the attention received by an individual article. (Altmetrics, 2019)

Altmetric/altmetric.com is a platform built for commercial purposes to determine the impact gained by research outputs individually and collectively, various solutions are being offered to serve different commercial purposes associated with research outputs. Altmetric as a platform utilizes the same philosophy of impact measurement is being utilized as defined in the altmetrics manifesto. 'Altmetric manifesto' or the philosophy behind the alternative metrics was published with the arrival of altmetric in 2010.

Article-level metrics is an underlying concept of alternative metrics, but the article level metrics are more complete in terms details as the contain all the associated with single article under focus. Article-level metrics are based on all the data including the usage metrics, social impact and traditional bibliometrics citation counts.

AAS/Altmetric Attention Score Altmetric attention score or AAS is derived score represented in numerical form usually in whole number form to represent the attention received by an article over the web, including social media platforms, blogs and news websites etc.

Author Level Metrics is another form of metrics which usually provides the information related one author. Usually these metrics are available on authors websites or profile pages to indicate metrics analysis results of all the research outputs by a specific author/researcher/scholar.

Research Dissemination is a process by which a research output is usually distributed in public or in scientific communities, dissemination process can vary concerning to traditional and new emerging processes. Most frequent means of research dissemination are websites, video, conferences, short report publications and seminars.

Social media is combination of different platforms and networks being used across the world for the purpose of communication and recreational activities, platforms include Facebook, Twitter, Google^{+} etc.

Figures

Tables

Contents

1. Introduction

The evolution of scholarly communication is consistent all over the time as it gets better and better with the arrival and utilization of different modern technologies in the different fields of research and development. The development of modern techniques and technologies helped communication means to improve and grow further, the tremendous growth of web technologies and web enabled platforms totally revolutionized the patterns of scholarly communication since the advent of internet and web technologies (Thelwall, Haustein, Larivière, & Sugimoto 2013).

As the social media platforms emerged and transformed the ways of general communication around the world, it has also affected the presence of scholarly communication over the web. Finding the impact of disseminated research outputs is a trending curiosity in today's world of informatics and sciences. The presence of various approaches to determine the quality of disseminated research work is not just simply enough. The traditional citation-based approaches are clearly exhibiting the limitations in the presence of evolving web technologies and social media platforms. The need to address the limitation of traditional approaches is already being addressed with emerging approaches having the compatibility to address the issues and present the information extracted from today's modern-day web technologies and ever-growing communication over the web. Bornmann (2014) indicates the primary limitation of traditional citation-based approaches is the inability to measure and present the information regarding the societal impact created by the dissemination of the research work over the web.

The presence of altmetric or alternative metrics approach was initially proposed to address the limitations of traditional citation-based approaches or webometrics. The alternative approach utilizes the web-based indicators to measure the impact research outputs, which makes it totally different from other old or existing approaches. The alternative metrics use another commonly known term altmetrics attention score to depict the impact of research outputs in the form of whole number i.e. from 0 to 5000 or more. The AAS is basically a unit to present the quality of the research output in terms of attention received from mentioning and reading counts over the web platforms. (Pardeep & Thelwal 2014). The altmetrics or alternative metric is imagined and proposed as a supporting approach to help and sustain the traditional approaches. Though the emerged and proposed solution itself is evolving and the outcomes in terms of impact calculation are not ready to be adopted as much confident and assuring.

The effects and evolvement of altmetrics can be seen on many platforms such as research databases, digital libraries and publisher's websites as the use of altmetrics and altmetric attention score as a promising indicator to indicate the consideration and intention gathered by the disseminated research output. Generalization of altmetrics or alternative metrics is not simple due to AAS calculation as many factors are involved from its impact calculation to its ranking mechanism of research articles, and other forms of research output. Scientist and research scholars are continuously evaluating the altmetrics as a possible alternative approach regarding its wider impact determined aspects and beneficial outcomes.

The altmetrics attention score of other related information indicators is quick and yield in very less time as compared to traditional citation-based or peer reviewed approaches. (Thelwall, Haustein, Larivière, & Sugimoto 2013).

Presently, as the research and discussion regarding the altmetrics and its utilization regarding its effects and benefits are increasing, the relevant topic of this thesis study is chosen to evaluate the automatic as a platform reading its benefits and limitations in the process of research dissemination. The subsequent chapters of this thesis study are dedicated to expanding the elaboration with the help of existing literature also to discuss the altmetric as a platform for alternative metrics in elemental details.

The impact and indicators about a published research articles or research outputs are relevantly key information required to evaluate the research work at a glance, researchers were always looking for a quick method or visualized information system to determine the quality aspects of articles dispersed over various research databases and digital libraries. For scholars finding the most relevant and highly cited articles was a challenge as traditional citation-based or webometrics approaches doesn't indicate the true impression of papers, peer reviewed articles or any sort of published research output. Altmetrics as a comparatively new approach resolves some of the issues associated with earlier approaches. (Sud & Thelwall 2014). Highly cited articles based on citation count can provide the qualitative information of research but lacks in providing the exact impact and attention received by the highly cited articles.

The societal impact and recognition over the web generated by the research output is difficult to determine with just citations, the other important factor which makes the situation based approach limited is the time factor, citation count takes time accumulates and over the passage of time it becomes very difficult for scholars to determine the true impact. The time an article can take to receive citations could be a very lengthy process to determine the quality of the article based only on citations. (Mohammadi & Thelwall 2013). The new trend over the publisher websites and other digital libraries is to mention both the information related to citation count and attics. Various publishers across the web are publishing the metadata related to citation count and altmetrics score directly on their websites, which is somehow helping the readers and scholars to determine the scope and quality of mentioned or cited articles.

Apparently, the usage of both citations counts and altmetric is an easy method to correlate the two different methods, but the important factor which could break this process is the growing number of articles and research outputs. As mentioned, discussed by Cameron Barnes (2015); Costas, Zahedi, and Wouters (2014); Fausto et al. (2012); Haustein and Siebenlist (2011); Huggett 2012 & Waltman and Costas (2014). The correlation effects to of altmetrics are still required to be studied and analysed with larger number of articles. Often the results collected by correlations of above studies and other scholars, the association drawn between altmetric measures and citation count is still not enough to elaborate the correlations as strong indicator, though the reasonable evidence is also present to support the argument of correlation results. (Fenner, 2014).

For the scholars and scholarly communication, the determination of the impact is critical. The impact of a research output cannot be fully quantified, and the quality aspects also can't be determined from just the quantifiable details or just numbers. Today, the research is mostly evaluated by the citations, peer reviews and including the webometrics up to some extent but the ignored factors or measures by altmetrics are giving another

dimension to research evaluation. Across the globe there not a single method to evaluate the research and its outcome but combinations of methods are being used to determine the quality aspects and its reach. Previous research in the area of alternative metrics was limited to limited source of platforms like 'CiteULike', 'Mendeley' or different other bookmarking and reference management tools only. Indicators and data collected from these limited sources also indicated the reasonable relation between citations and altmetrics. (Priem, Piwowar, & Hemminger 2012).

This not only use to encumber the new research discoveries from the impact it was capable to make but also it was difficult for the researches to bring any policy change and reach the public (Chen, Diaz, Lucas, & Rosenthal, 2010). But now, it has become quite easy for the researchers to spread their work related to the target audience of a research domain. Whenever, we talk about research dissemination, we always relate it to the publication of the research in peer reviewed journals which is not only a difficult process for the researcher, but it often fails to reach the public and bring any change in their life.

This lack of understanding and clarity in the research community, that dissemination is not only related to other researchers has resulted in the time lag of different research findings and their potential of causing any positive impact on the society (Buxton et al., 2008) As a matter of fact, there are thousands of research studies going on worldwide, in every field, but these studies often fail to make any impact in their respective fields or make any change in the policies due to the absence of the process which can be used to disseminate the knowledge (Nutley, Walter, & Davis. 2003).

As Trueger et al (2015) mentions, though understanding the altmetrics as an emerging approach is complex as the approach and tools offered by different services providers is evolving, the commercial tools are focused to provide results and details to be used primarily in the business and commercial purposes. The altmetric.com is such an example of a commercial service provider to offer various altmetrics based solutions for research impact determination by article and author level metrics. (Melero, 2015)

The primary and intended aim of this thesis is to present the understanding of altmetrics and evaluate altmetrics as emerging alternative metrics approach to support existing citation-based or traditional approaches. Since the altmetrics manifesto and its advent the term altmetrics itself has received a substantial amount of attention in scientific communities as a promising indicating method for the determination and specification of direct true impact of disseminated academic work over web-enabled platforms. Though, being an emerging method the altmetrics has significant potential in it to be studied further with respect to its benefits and limitations and how altmetrics is contributing effectively in domain of research and knowledge dissemination process (Thelwall, Haustein, Larivière, & Sugimoto 2013).

Today, key idea behind the adaption of alternative metrics has been identified as it has already evolved and developed in a way to quickly capture the information of recent or older research outpost mentioned over the web and social-media platforms. Thus, the associated factors with the potential of altmetric as an alternative approach has a motivation for researcher to study and explore the platforms and approach itself to answer many dangling questions around it. For the exploration of intended research questions, the study is intended and designed to use literature review approach to find suitable and related existing literature and extraction of relevant knowledge to conclude the answers for the aimed research question. In the subsequent second chapter the basic idea the

altmetrics is discussed. The subsequent chapter elaborates the concept of altmetrics to establish the understanding with the subject. The chapter three discusses the implementation of research method and data collection. The subsequent chapters four and five after research method specifically discuss the related study and extracted results as findings. Finally, the discussion and conclusion of the study are discussed in chapter five and six respectively.

2. Altmetrics

This chapter is intended to discuss the background study related to altmetrics. The chapter is aimed to make a proper relevant background knowledge related to the scholarly communication and how the further development in technology lead to the beginning of the subject altmetrics. Further continuation with the topic the primary understanding with the subjects involved in this study is critical. The scholarly communication is a primary aspect in the entire research dissemination process. To understand and the subject a literature review has been completed to construct a logical relation to the subjects involved in this domain. This chapter mainly discusses the subjects considering prior work done by researchers.

Way before the internet technology, different tools which were used for the research dissemination were publishing the articles in a peer reviewed journals, writing research reports, books, policy briefs and press releases. The biggest flaw of these tools was consumption of time as it used to take a lot of time in research division (Sugimoto et al. 2017). But now, with the invention of great technologies like the internet and with the presence of social media, it has become quite feasible and easier for the researchers to spread their work among people on a larger scale (Duffy, 2010). With the ever-evolving means of research dissemination, social media has played a significant role. Researchers have taken a great benefit from the social media to diffuse their work with people on a wide scale. Now without having any hassle, researchers can use the platform of social media and get the instant reaction of people and the output regarding their research. According to international telecommunication union, there were five hundred million internet users back in 2001 which then become 1.2 billion in 2005 and in 2010 according to the estimated value, there were 1.9 billion users in 2010. (ICT, 2010). By these statistics, we can get the idea of the importance of the internet and the social media networks like Facebook and Twitter.

Three types of tools were introduced by Cann et al. (2011) which can be used for the research dissemination and which are highly important for knowledge mobilization. These tools have been categorized because of the functions they perform, how they help in communication, and collaboration and multimedia. For the research communication and general cycle of research can be used for the identification; these stages include the identification of the knowledge, creation of the knowledge, making sure that the knowledge which has been produced is of good quality and the large stage which involves the diffusion of the knowledge. According to a research conducted by Cooper, (2014), the number of researchers who were working with the collaborators are more in numbers as compared to those who were not working with the collaborators. Proctor, Williams, & Stewart. (2010) found the same thing in their study, which concludes that those researchers who are working in collaboration in different institutions are higher in percentage than those who are not working in the same way. These researches not only show the involvement of researchers in social media, but also shows how the usage of social media is dependent on the collaboration (Aung, Erdt, & Theng, 2017).

Aung, Erdt, & Theng, (2017) mentions the usage of social media can be fruitful for the researchers as it not only boosts up the influence of the research, but also help in creating and raising the profile of the researcher. It has a far-reaching impact and it also help the researcher to get his work reviewed by other researchers of the respective field which

might be out of reach for the researcher due to distance or some other factors. Bakshy, Rosenn, Marlow, & Adamic. (2012) have discussed how social network not only influence the human behaviour, but also reflect their interest regarding knowledge which is present on the social media which is not very much visible through observational method. According to them the knowledge of the social media has a far-reaching impact than any other source of communication. The knowledge mobilization on social media take less time and gives instant results which shows that importance of web enabled platforms for communication on research dissemination. Social media is comprised of many social networking sites like Facebook, Tumbler, Instagram, Twitter, etc.

Among various and widely used social media platforms Twitter is considered most active and purposeful platform with 330 million monthly active users. It is basically a micro blogging website which helps in sharing the information in the form of tweets. Twitter is one of those websites and many of the researches has been conducted on the role of twitter and its different aspect like how it is affecting the behaviour of the people, how it has an impact on the interest of different people, how it is helping in knowledge mobilization either it is scientific knowledge or not. (Elmore. 2018) Twitter is helping the researchers to find out the instant reaction of the public regarding their research, not only this, but it also helps the researcher to diffuse their research in a broad range of people especially other researchers. Twitter among other platforms also helps the researcher in getting their work reviewed by other researchers in a short time period. So basically, twitter is a useful in providing the important indicator to assess the communication and impact gained by the disseminated work.

The vibrant important and adapted characteristics of social media platform in research dissemination is importantly discussed widely by various scholars. Hence, researchers, academic institutions and funding bodies have become interested in measuring online impact of research. The alternative metrics as an emerging approach to calculate the impact of scholarly work over the web especially in social media platforms has gained a significance and the role of altmetrics has significantly increased. The altmetrics as an alternative metric to traditional citation-based approach gave another perspective to the researchers to see the visibility and the impression of research work mentioned or discussed over the web. (Fenner, M. 2014)

Terras, Ross, Warwick, & Welsh (2011) have discussed how Twitter can be used in different conferences. They have investigated different aspects of usage of Twitter. They have discussed, how twitter can help in the diffusion of knowledge and its co-construction. Twitter can play a significant role for scholarly communication especially in conferences and seminars, which can effectively engage the users and scholars to communicate and participate at the same time in different conferences. Shiffman, Darling, Côté, & Drew. (2013) have discussed the important role of Twitter for research dissemination in the impact measurement cycle for mentioned or discussed scientific publications. According to them, Twitter can be used as an informal platform to get the work reviewed from other researchers which not only result in hassle free research but also it less time consuming. They have discussed how effective Twitter is in spreading the knowledge in the form of research. Bruns & Burgess (2012) have discussed how Twitter is evolving as an important tool in spreading the news to people and how much it is effective in knowledge mobilization. When a researcher succeeds disseminating their work efficiently. The next step involves the quantitative analysis of the research output,

for which different metrics have been adopted by the researchers which includes, bibliometrics and alternative metrics also known as altmetrics.

The previous methods of measuring the citation impact used were bibliometrics in which the citations were calculated for a published article to know the impact factor of that article, but now alternative metric has been used to do the quantitative analysis of the research impact. Altmetrics is a tool through which we can have a flavoured quantitative analysis, as it not only measures the number of citations, but it also helps in the evaluation of the response which an article gets from its audience after it is published. (Priem et al., 2012).

Bornmann & Haunschild (2018) has conducted a research in which they studied how the data obtained through altmetrics for the dissemination purpose of research through twitter can have false results. Discussing the inconsistencies coming in the way of using altmetrics while disseminating the research, Meschede & Siebenlist (2018) has argued the significance and the limitations of altmetrics. According to them altmetrics can be used to know about the attention a research receives but this attention cannot be generalized as different sources of altmetrics can give different results which shows that there are some limitations of using altmetrics. To avoid this problem, further analysis should be done to evaluate and assess the sources using qualitative methods.

In his paper "A systematic identification and analysis of scientists on Twitter" Sugimoto et al. (2017) have discussed the limitation of altmetrics while evaluating the research impact in research dissemination. Though altmetrics have been playing a significant role in the analysis of citation impact, but it does have some limitations and due to these limitations, it can only supplement the already existing metrics, but it cannot replace them completely Thelwall, (2013). Altmetrics can identify the highly cited publications with very much precision, but still it has some limitations and it cannot be labelled as the only source serving the purpose Zahedi et al, (2015). Number of researches have been conducted to highlight the importance of web-based communication platforms and the significance of altmetrics in process of research dissemination and impact measurement.

These researches have shown how on the one hand automatic has a great significance in the evaluation of citation impact, but on the other hand it has also showed that this type of metrics does have some limitations and we can't solely rely on them regarding the analysis of citation impact. The intended aim for this study is to generally assess altmetrics as an alternative metric to understand its limitations and its advantages as an emerging technique to determine the impact of research. As existing literature has already identified the altmetrics as a significant technique, but it has also mentioned some key limitations. The following chapter presents the existing literature about this thesis study.

1.1 Altmetric as a tool?

Altmteric being most prominent tool to measure research impact over the web offers various solutions with respect to demands and requirements. The most generic form of the results could be found from publishers' websites, where altmetric score badge is present for individual articles to depict the attention score of an article received over span of time. Apart from the altmetric attention score details and mentioning counts, altmetric also provides customized solution for publishers, institutes and research funding organizations. These specialized tools are explorer for Publishers, explorer for institutes and altmetric explorer for funding organizations. The utilization of each tool is specific

to its reasons and group of people with different motives and the level of details also differs as the scope varies. The focus of this study is to explore the altmetric on a generic level with respect to research dissemination. (What are altmetrics? 2018), (Elmore. 2018).

The in-depth exploration of other platforms such as altmetric explorer for institutes and funding organization would out of the specified scope of the study. Though, altmetric explorer (elementary or generic version of explorer) for researches being a platform needs to be mentioned and discussed as the utilization of this platform is growing faster among researchers to measure and determine the impact and dissemination of research with respect to associated details. Mostly, the services offered by altmetric in form of explorer platform are paid and specialized to its usage. The general level altmetric details encompass various information obtained from various web resources.

The data gathered from all the web sources is analysed and processed differently as altmetric ranks and evaluate the source differently, which means not every web resource where a research work is mentioned or discussed always contributes towards article level attention score. (Barnes. 2015) and research studies related to altmetrics score calculation and weightage commonly marks and list the resources under consideration as following:

- Twitter
- Facebook
- Google+
- Blogs
- CiteULike, Mendeley etc.
- Various Peer review services
- Global Academic networks
- Wikipedia
- News
- Videos

The list of resources for altmetric score calculation, what are altmetrics? (2018, December 17)

The altmetric collects all the above listed data from different source to calculate the altmetric attention score for mentioned articles, studies, or published research work. Each source of attention is different in terms of attention proportions. The collected data is not necessarily meant to be processed in same fashion; the set of analysis also varies for each source of data. Thus, the individual calculation of each source of data leads to a whole number of attention score. (Barnes, 2015), (Torres, et al. 2013) Since 2010 and after the publication of altmetrics manifesto the rise of the terminology has been continuously growing further. The prospects of altmetric in finding the research impact is broad and as per their claims the affect is also wide or more auspicious. For many researchers and publishers this is not the case. What exactly altmetric describes it platform to contribute towards research dissemination and gauging the impact or attention is extensively bragged and described by altmteric.com.

The altmetric is not the only tool to measure the research impact by utilizing or focusing the alternative metrics as an approach, the two other prominent names include PlumX and Impact story. The PlumX is leading in terms of article repository size containing more

than 25 million copies of articles whereas altmetric is staying second having approximately 5 million articles under its badge.

The level of details provided by each platform varies and the focus on score calculation also differs with respect to certain factors of sources and weight distribution of scores with respect to platform of sources and credibility. Altmetric being platform for alternative metric approach offers its impact factor calculations and its benefits in three main categories.

As many scholars have identified and discussed the purpose of the altmetrics, the platform itself is totally data dependent. The dependency factor on data from different sources contributes to a single calculated number of attentions received by a disseminated research work. The primary purpose of its attention score is set to serve many purposes including evaluation of existing or disseminated work for project funding, to determine the quality of work and to encourage the junior researchers to reach out loud in scientific communities. Altmetric platform holds second largest data repositories in terms of research article and mentioned research works. The algorithm behind the scenes analyse the contents continuously and rank the paper with respect to attention received individually.

The exact working of altmetric data analysis algorithms is still a mystery as the score calculation is not broadly discussed or elaborated by the altmetric as a vendor. The tracking of papers is relevant for many scholars to be explained and reviewed. The very first glance at altmetric attention score could be insightful but limited as the user is unable to grab the idea behind the AAS calculation logics and representation of different data sources associated with dispersed research work. (Altmetric. 2019)

The flow of the information from altmetric to its result details page follows a process involving data analysis processes and ranking of papers. The Altmetric result page of details page gives an insight to many details linked with mentioned or ranked paper. The mentioned work can be traced back to its original referees and mentioned web links to trace all the activity associated with the research work mentioned or under consideration. For a naive user or a person not aware of altmetrics' working mechanism can understand the impact generated by the published and shared research output. John Templeton Foundation, Altmetric.(2019) by keeping in the view that altmetric mostly rank and track the publications, journal articles and various other types of research outputs but the scope of data is not just limited to mentioned outputs, altmetric tracks and analyse almost all the literature mentioned over the web. The features and different platform options from user to user makes it a highly popular and accessible data driven platform to determine the research impact (Elmore, 2018).

1.2 What altmetric offers

As many scholars have identified and discussed the purpose of the altmetrics, the platform itself is totally data dependent. The dependency factor on data from different sources contributes to a single calculated number of attentions received by a disseminated research work. The primary purpose of its attention score is set to serve many purposes including evaluation of existing or disseminated work for the evaluation of project funding applications, to determine the quality of work and to encourage the junior researchers to reach out loud in scientific communities (Elmore, 2018). Altmetric platform holds second largest data repositories in terms of research article and mentioned

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Understand your audience

The communities engaging with your research each have their own goals and preferred channels. Altmetrics provide a new level of visibility into the varied interactions that take place every day. [1]

Key opinion identification

Altmetric tracks and collates mentions from thousands of sources in real-time, making it easy to determine who is drawing a lot of attention to your research and driving the discourse. [2]

Competitive analysis

Powerful insights into the reach, influence and potential impacts of research published by other organizations that can be factored into strategic planning. [1]

Horizon scanning and trend analysis

The immediacy of altmetrics data makes it possible to identify emerging trends and topics whilst monitoring the broader research landscape at the same time. [1]

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[1] To complete the chapter regarding the offers of altmetrics as a platform the above information was mainly retrieved from: altmetric. (2019). Altmetric for Funders. [online] Available at: https://www.altmetric.com/audience/funders/ [Accessed 12 Apr. 2019]

[2] To complete the chapter regarding the offers of altmetrics as a platform the above information was mainly retrieved from: Altmetric. (2019). Utilizing Altmetric tools to achieve institutional targets at the John Templeton Foundation. [online] Available at: https://www.altmetric.com/case-studies/the-john-templeton-foundation/ [Accessed 7 Mar. 2019]

Reputation management

Altmetric displays online conversations surrounding your search once it's published, which means you can make sure it's not misused or misinterpreted. [2]

Publications planning

Make data-driven decisions to ensure maximum ROI from your publishing and marketing activities. [1]

Uncover stakeholder insights

Altmetric data and tools can be used to improve the effectiveness of publication planning, understand which outlets your stakeholders are using to find their medical information and uncover influencer trends within therapeutic areas. Altmetric data can be helpful in supporting return on investment analysis when examining the value of your current content portfolio; it brings a new dimension to how content is being used.[1]

Showcase your research

Building your own platform or database? Enhance your publications, posters, conference presentations and clinical trials with Altmetric badges – colourful visualizations that can be easily embedded into any platform to provide an at-a-glance summary of the online attention an item has received (Elmore, 2018).[2]

As Elmore, (2018) suggested the altmetric badges update in real time to show:

- The Altmetric Attention Score
- The number of mentions per source
- The breadth of attention received

Services

- Custom visualizations of Altmetric data
- Custom Data Queries
- Custom analysis and reports
- Poster and presentation engagement tracking [1]

Web solutions:

Altmetric badges – Add the colourful Altmetric badges to your platforms to showcase the engagement surrounding your research.[1,2]

- Commercial API – Display and analyse altmetrics data how you want, where you want exactly.[2]
- Explorer platform – What attention is your company's research receiving.[1]

2. Research methods

This chapter is planned to elaborate the process of research technique used in this thesis study. The chapter also discusses in detail the entire research process from research problem identification, devising the research approach and collection of data and the primary studies for this thesis study to be included to answer the proposed and designed questions.

This thesis research work is intended to utilize qualitative data and narrative investigation to answer the proposed designed questions. To keep the scope of the collected data relevant to research questions and to obtain more related qualitative literature from major selected databases will be analysed with respect to the targeted research question and the relevant keyword combinations will be used too. Only, related scientific literature as per the inclusion and exclusion criteria will be used in analysis and comparison. The selected systematic literature related to altmetrics and altmetrics attention score will be studied and compared respectively.an

2.1 Research problem

The research problem intended to be explored and examined in this study is linked to the impact of scholarly work discussed over the web-enabled tools and platforms for communication among these platforms twitter stands more prominent as its being used more frequently used by the scholar to disseminate their research work. How does the altmetrics as an emerging platform indicates and measure the impact of research outputs and what exactly the number behind the altmetrics attention score express about the research output. To explore the topic in depth and extract the meaningful information about altmetrics and altmetrics attention score following research questions were developed to find the solution to the stated problem:

1. What is behind the altmetrics attention score?

2. What are the opportunities and limitations of altmetrics?

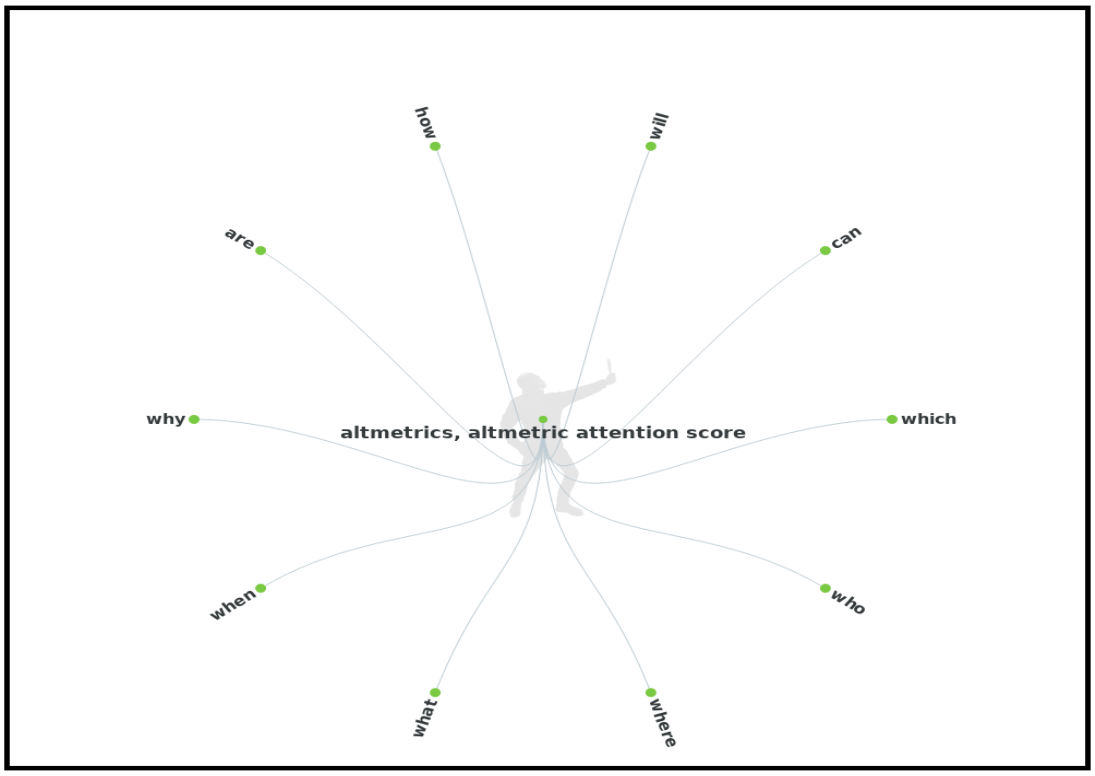

Figure 1: Scope of Research Question

2.2 Research approach

The research approach selected for this intended study to find answers from existing literature is a combination of qualitative data analysis approach and review of refined literature in narrative based mode as a source to target and make relevancy knowledge base to answer the research questions.

By following the narrative based approach, the aim is to distinguish the points related to observations and narrative of scholars about altmetrics as an alternative metrics approach. The study is also intended to clarify and elaborate the results in the form summaries from the collected literature related to narratives of scholars. The data will be collected as per the guidelines specified for the literature review and narrative based literature review approach. The Subsequent chapter of research methods will explain the applied methodology in detail with all steps of execution. Intentionally the intended thesis study is aimed to follow and utilize the literature review guidelines proposed by Machi and McEvoy, (2016). and Kitchenham and Charters, (2007) for the completion of research methodology.

2.3 Data collection

This intended thesis topic was narrowed to the currently selected topic after internship in summer 2017 with Dr. Arto Lanamäki, after completing the internship, I discussed with him to continue with the topic for the master thesis. To continue with the topic further familiarity and understanding was required with the platforms and the topic itself. Thus, the existing literature collection for the topic understanding started in late 2017. Finally, after narrowing the topic and formulation of targeted research questions in the final data

collection in accordance with the topic and research questions began in late December 2018.

The actual data collection for this study was re-started on 3rd January 2019 and completed on the 4th of January 2019. For the qualitative data collection this study is designed to utilize four scientific databases. Following mentioned databases for the data collection will be used to collect most relevant and recent studies related to the topic of the study. The intended databases are as following

1. Google Scholar
2. IEEE Xplore
3. Web of Science
4. ScienceDirect

The targeted databases will be the primary source of collection of scientific literature obtained and examined. Keyword combinations were also used to dig the material with relevancy to the topic. As per the designed inclusion and exclusion criteria intended study will utilize peer reviewed articles, conference articles, existing literature reviews, conference reports and proceedings. Following Table 1 and Figure 2 contains the total number of hits received for searched and targeted keywords from each selected scientific database.

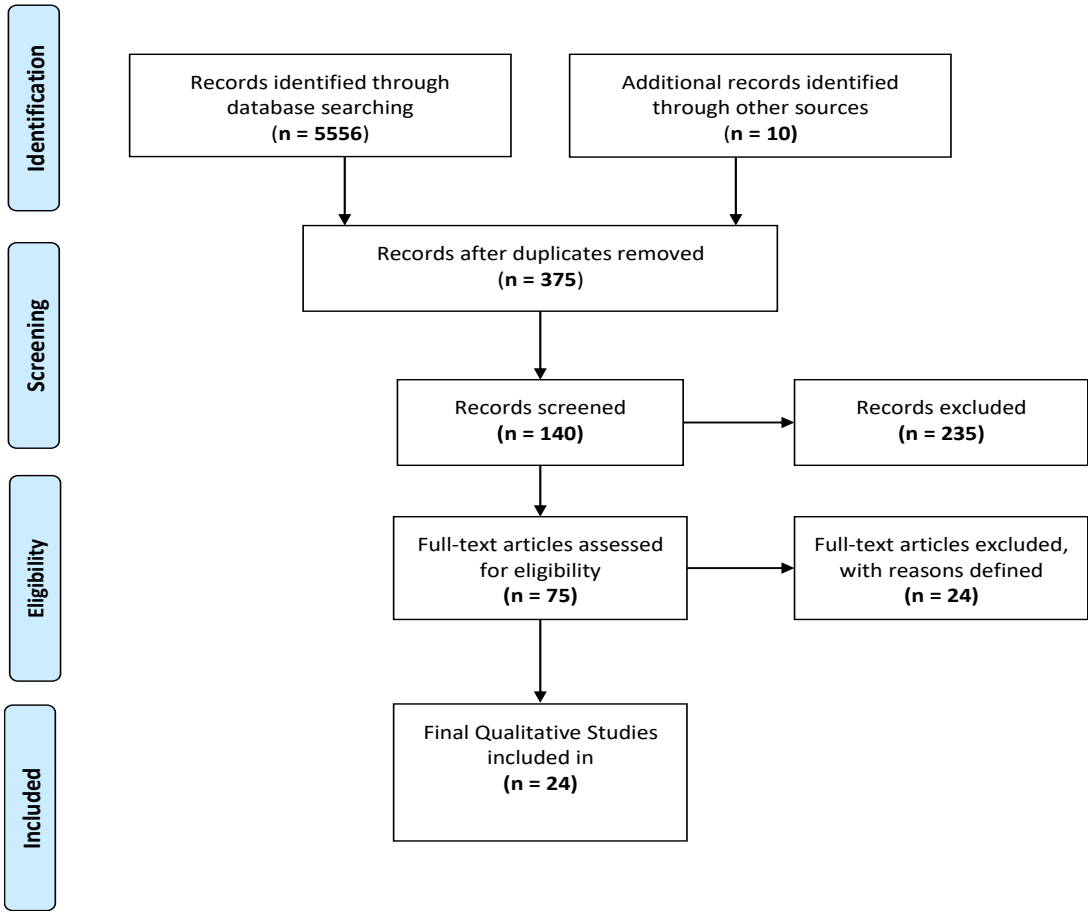

Figure 2: Prisma Data Collection Flow Diagram, (Moher et al. 2009, p.877)

Following table describes the total number of hits received by executing the search for each mentioned combination of keyword and synonymic combination of keywords.

Table 1: Total number of hits received on keywords & combination of synonymic keywords

Databases	**"(Altmetrics OR Altmetric) AND (Research Impact)"**	**"(Altmetrics OR Social media metric) AND (Research Dissemination)"**	**"(Altmetric AND Limitations) OR (Boundaries Altmetrics attention Score)"**	**"(Altmetric AND Opportunities) OR (Merits Altmetrics attention score)"**
Web of Science	380	234	221	369
ScienceDirect	335	312	479	474
Google Scholar	720	631	700	540
IEEE Xplore	81	29	23	24

Following pie chart represents the total percentage of hits by searching the combination of keywords from targeted research databases. The information present in the following chart is derived from Table 1 with a purpose to quickly understand the percentage of each database regarding the collected research papers.

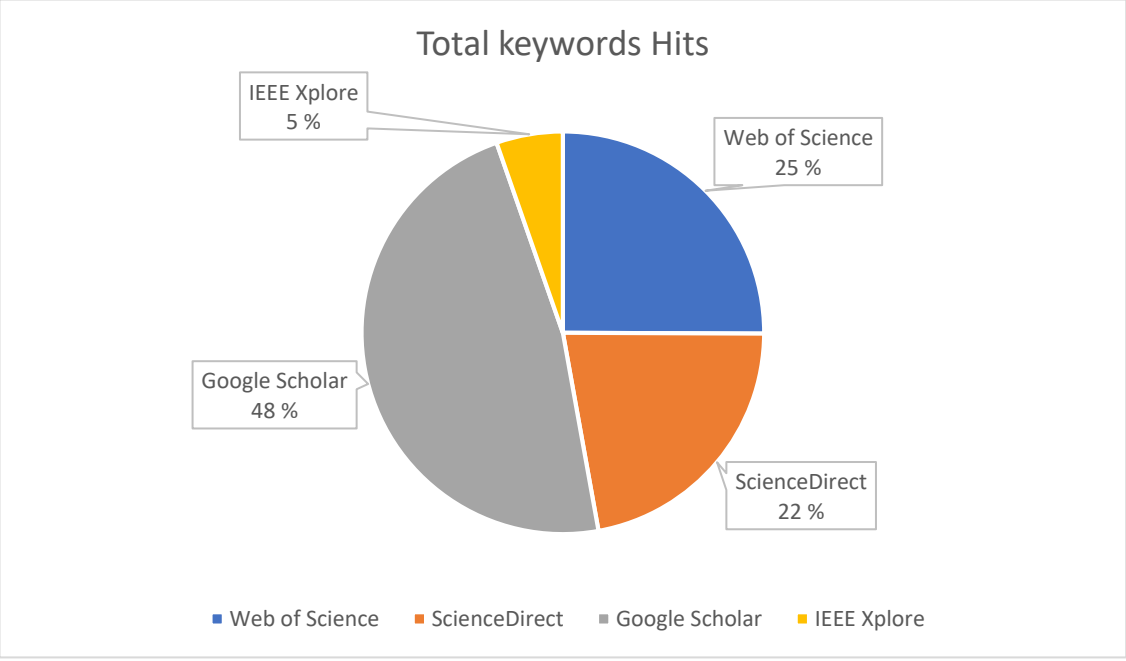

Figure 3: Total Number of Keywords Hits

2.4 Inclusion & exclusion assessment criteria

To collect the most relevant research articles from existing literature the study utilized some defined criteria for the selection of primary research studies. Following table in the list the exclusion/inclusion criteria used to filter out the collected data based on keywords hits.

Table 2*:* Inclusion & exclusion criteria

Inclusion criteria	**Exclusion criteria**
Usage of only latest version of the study published in more than one journal or conference.	Irrelevant document from other disciplines.
Must be written in English	Non-information processing science related document.
Publication Year 2011-2018	Primary titles that scope is clearly outside the scope of topic.
Abstract Screening - Any Altmetric or research dissemination over the web activity described with the intention of research impact.	Short papers, duplicate articles, non-English and not peer reviewed articles.
Open access and freely available articles only	Paid articles.

2.5 Data analysis

Total number of articles selected as primary reference of study are as following:

Table 3: Total number of articles received article after refined search

Databases	**"(Altmetrics OR Altmetric) AND (Research Impact)"**	**"(Altmetrics OR Social media metric) AND (Research Dissemination)"**	**"(Altmetric AND Limitations) OR (Boundaries Altmetrics attention Score)"**	**"(Altmetric AND Opportunities) OR (Merits Altmetrics attention score)"**
Web of Science	10	32	29	25

ScienceDirect	24	48	36	39
Google Scholar	21	15	17	10
IEEE	16	14	09	11

Subsequent pie chart represents the total percentage of articles received from each targeted database after refinement and application of inclusion exclusion criteria. The information present in the following chart is derived from Table 3 with a purpose to quickly understand the percentage of each database regarding the refined research papers after quality assessment.

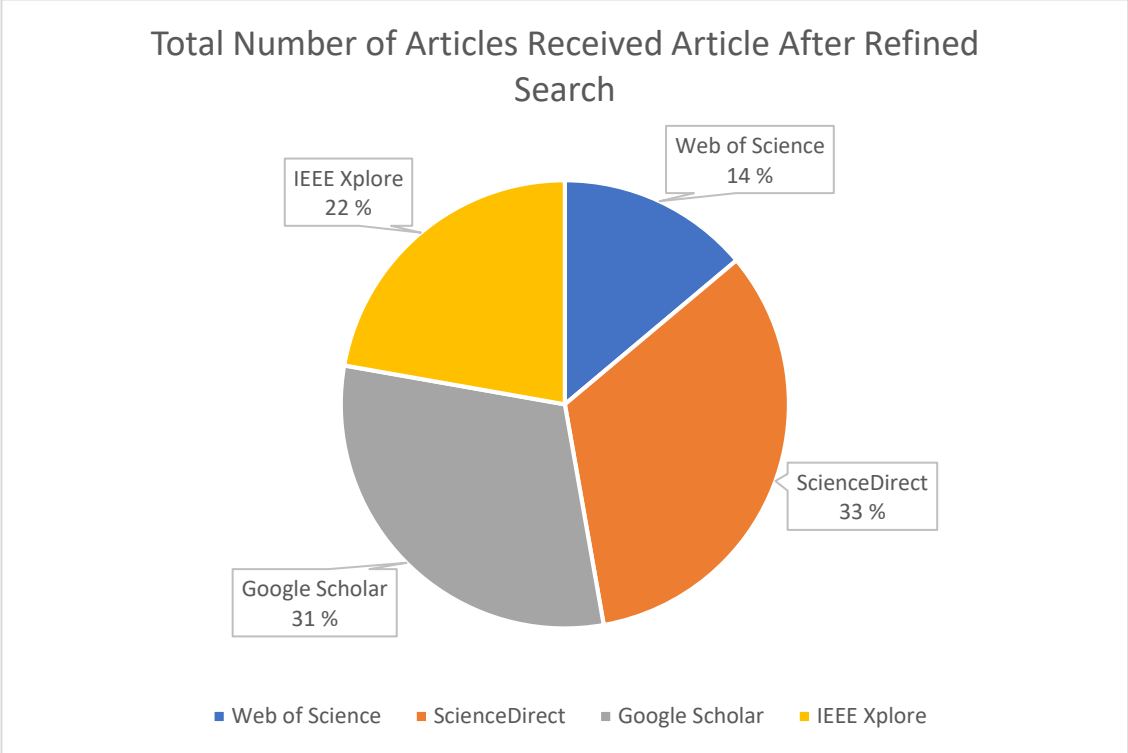

Figure 4: Number of Hits received after refinement criteria

After refining the searches and removing the possible duplicate number of articles retrieved from selected database sources total new hit was recorded as 356 number of articles. After filtering and making applying quality assessment criteria only 24 articles were received to be included in the study as primary source of literature for background work. The selected 24 articles are more relevant to the selected topic and targeted research question. Following Table 4 contains the final number of articles to be read extensively.

Table 4: Total number of selected articles for inclusion

Databases	**"(Altmetrics OR Altmetric) AND (Research Impact)"**	**"(Altmetrics OR Social media metric) AND (Research Dissemination)"**	**"(Altmetric AND Limitations) OR (Boundaries Altmetrics attention Score)"**	**"(Altmetric AND Opportunities) OR (Merits Altmetrics attention score)"**
Web of Science	2	3	1	0
ScienceDirect	2	1	0	0
Google Scholar	5	4	1	2
IEEE	1	2	0	1

Following chart represents the total percentage of selected articles to be counted and used in primary articles from each database. The information present in the following chart is derived from Table 4 with a purpose to quickly recognise the percentage of each database regarding the final selected research papers.

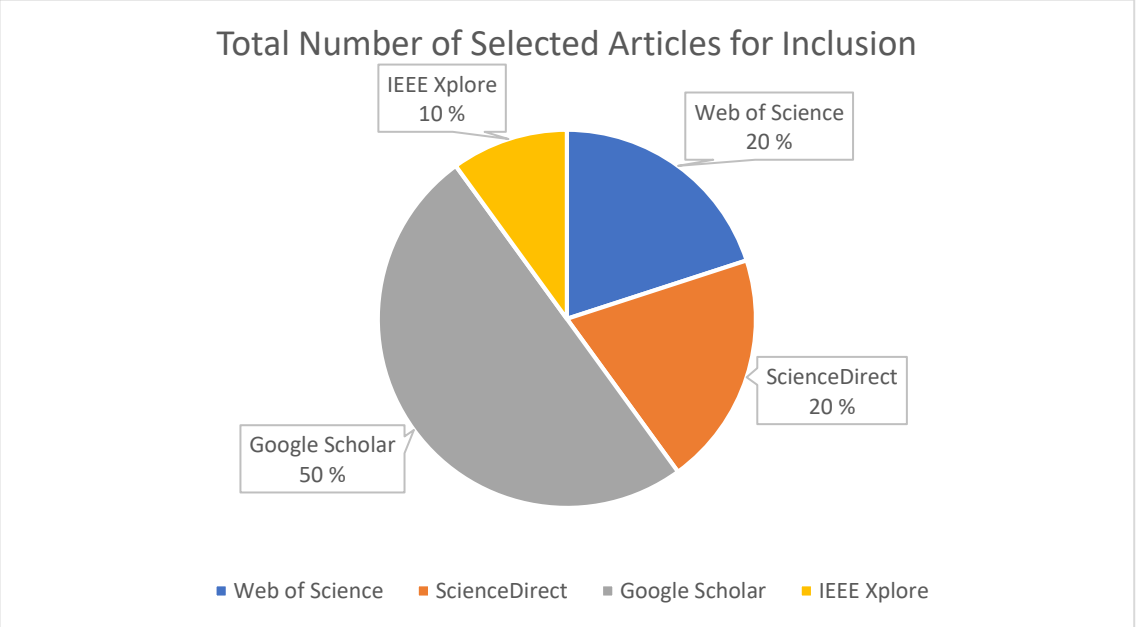

Figure 5: Total number of finalized selected articles

3. Findings

This chapter is intended to explain the results and results of the conducted review. The primary studies selected in data collection part are analysed thoroughly to obtain the relevant answer for the designed research questions is this present chapter of findings. The total number of selected primary studies is 24 and the given studies are mentioned in subsequent table in this chapter also in appendixes. Mostly, the narrative of the selected studies will be explained in a summarized manner to answer the research question.

3.1 Altmetric attention score

The altmetric attention score or mostly abbreviated on publisher's websites as 'AM' score is whole number most commonly presented as a badge or metric score on publishers, journals and digital libraries' websites. The altmetric attention score at first instance, gives a reader the overall score of attention received by the article over the internet. The doughnut or the score badge is a composite representation of information retrieved from different sources scattered in the form of the web. Whenever readers access the article level AAS information the first piece of information is always the altmetric doughnut which provides the article level attention received in a versatile perspective.

In his paper, Ortega (2017) has given the analysis on the relationship between the knowledge mobilization on twitter and how it influences on the research impact. In his study he observed four types of twitter account which included accounts of the journal, owner account and publisher account or without an account. After this he observed the number of tweets and citations of these four accounts and compared them with each other. According to his results, the journals having the twitter account get more tweets and citations as compared to those journals which don't have twitter account where the followers act as a variable and help in attracting more tweets but the effect these followers make is quite small. "In his paper Ortega, (2016, p 4) has found the relationship between the diffusion of the research and mention of the research on the basis that whether the researcher is a member of twitter or not". According to him the papers of twitter members are more tweeted than the papers of the researchers who don't use twitter.

[S17], [S7] Usually the colourful doughnut is depicted to represent the AAS on a publishing or Journal's website. Usually the colourful doughnut is depicted to represent the AAS on a publishing or Journal's website. For most of the articles the AAS is located somewhere around the title or author information. The doughnut could be represented in the multi-colour formation of round strips. The details of article level metrics are accessible by the user on altmetrics details page which indicate and in-list all the information related to attention received by the article or research output. [S7], The details page usually contain the information of attention sources and origin of attention sources and origin of attention sources which includes the social media mentions, including Twitter, Facebook and Google+ pages where the research output has been mentioned when and by whom. Further contextual details of AAS will be discussed in subsequent section to discuss in length with the help of AAS figures and illustrations. AAS describe the qualitative information of mentioned research output in quantitative way, which means the whole number present inside the doughnut state the quality in numerical way, implicitly higher the altmetric attention score number would be higher the quality of research output will be considered[S17]. Altmetrics is considered as an article level

metrics platform to provide details specifically for a mentioned research output. The contextual article level details are also available to be accessed by the reader. Following figures 3 and 4 depict the details of altmetrics score mentions on publishers' websites and the reader level details provided by altmetric.com about the targeted research output.

Figure 3: Stating of Altmetric Score on Publisher website, (Altmetrics 2019)

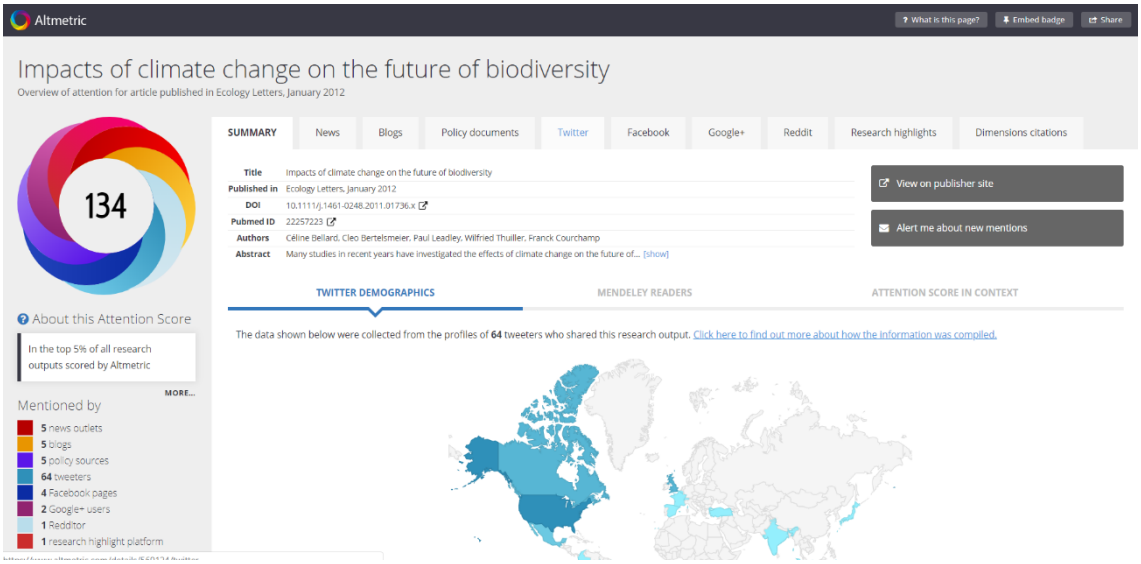

Figure 4: Reader Level Detailed provided by the altmetric.com, (Altmetrics 2019)

Social media has been a very important tool for Scholarly Communications. Scholars use up this platform in order to promote new and advanced indicators. In recent days, Altmetric, an acronym of Alternative metrics has gained immense success as an indicator primarily based upon social media activities [S9].

Basically, Altmetric is an advanced group of metrics which determines the effects of digital scholarship over the internet globe. Since scholars and researchers are constantly sharing their content and researches over the internet, Altmetric are used as legitimate indicators by most of the scholars. According to [S18], Altmetric is quite different from the conventional method of indication or citation. Previously, citation-based metrics like citation count or journal impact factors were used by the scholars as pointers in their work. According to the National Information Standard Organization (NISO), Altmetric is a special type of indicator which encloses different type of digital indicators that are linked to scholarly works. All these indicators are a part of the activities performed by the diverse scholars and stakeholders in the research atmosphere. Altmetric data is not only constrained to downloads, views and likes on social media but stuff like that is considered as a part of Altmetric Data. Altmetric Explorer and Plum Analytics are two important Altmetric aggregators. There are also some free facilities provided by the scholars over the internet for the same purpose i.e. Research Gate and Kudo[S17], [S18].

AAS is a calculated by the algorithms, the calculation depends on differentiating factors. The factors with respect to the visibility they offer. E.g. a mention in any blog or newspaper articles is more preferred regarding the research mentions on social media platforms [S13]. Also, mentioning of the author and the volume is also taken into consideration. [S13] asserted that this score is represented by a chief Altmetric Donut, [S7] which has a coloured stripe that indicates where an article is mentioned. Altmetric.com is a website which offers the users to calculate the score themselves. Another important thing that should be considered is that Altmetric is not a substitute for traditional citation method. On the contrary, it is a better version of the previously used citation method. Scholars still use the conventional way of indicating their research references in their work. According to studies, there is a relationship found between both sorts of indicators i.e. Altmetric score and traditional citation count. But fortunately, this relation is found to be weak and variable. A radiology study was made and used as a tool for comparing both the methods of indicators. Altmetric score did not correlate with the citation count [S13], [S18].

According to [S2], Altmetric encapsulates web metrics often referred to as cyber metrics. They study the direct association of the web platforms available such as websites and log files [S14]. Why most scholars prefer the use of Altmetric is because it is applicable in the broad spectrum of research. Governments and much other funding or lending organizations demand scholars interpret the social impacts. Traditional metrics were only restricted for scientific study and research, therefore, limiting the possibilities of case studying. Altmetric is appropriate for broader research framework [S1].

Altmetric Attention Score (AAS) is based on three factors:

- **VOLUME:**

The Altmetric attention score is increased as more and more people mention any article or piece of writing. At a time, only one mention is considered from a single source of attention or publication [S1].

- **SOURCES:**

Mentions of articles are differentiated because of the sources they are extracted from. For example, the percentage of weight for a news website would always higher.

- **AUTHORS:**

Weighed by three factors that are reach, promiscuity and potential bias. AAS is more raised rather if the same article is made an automated share via journals.

Altmetric Attention Score has got numerous applications in communication networks because it is convenient and easy to use. [S1]

It is not possible manually to identify an article posted by an author. Here an Altmetric aggregator comes in hand. It is efficient in gathering the statistics of an article posted by any author. Altmetric aggregator uses the persistent identifier to distinguish the identity of several authors i.e. ISDN etc.

Therefore, after the rapid growth of the internet, scholars needed a better way of indicating mentions in their write-ups. Altmetric is a new and effective method of indicating references of authors and sources of content. Altmetric Aggregator gathers information from various sources such as social media websites, blogs and news web platforms etc [S18], [S9].

3.2 How altmetric attention score is calculated

Digitally born data is saved and managed in the Digital Libraries. They are the collection of digital stuff created. After numerous studies, it is stated that institutional repositions and digital archives are digital libraries. Therefore, while calculating Altmetric Attention Score; these Digital Libraries are considered. The data of a digital library is read by an external. At times there is an internal functionality designed in the systems by the developers that can easily fetch the data from the library [S1], [S2], [S18].

The altmetric score is the weighted approximated score over all response author has received for the published research. There is an assumption made while calculating the score i.e. the groups that are compared should be of same measurement level. We will refer to this as measurement invariance or equivalence. If there is no measurement invariance, then the differences between the groups may lead to a wrong direction while calculating the score. An easy method of testing is by determining the congruence. Congruence is defined as the measure of proportionality of elements. In order to determine whether AAS is unidimensional and measurement invariant, the structure of two different groups will be compared. Firstly, we will take an article that is cited by most of the scholars but still does not hold a high Altmetric presence. Next, we will determine whether AAS is congruent throughout i.e. its functionality remains the same after several years of the initial measurement[S19]. In order to study the interrelation of traditional citation and Altmetric, a similar process is held up for tradition citation and various conclusions are drawn out of it. If we can get a one-dimensional and congruent Altmetric between the compared groups, it would give us a certain amount of empirical support. On the contrary, if the results are low congruent then AAS needs to be considered again. [S19].

There are two types of Altmetric and hence two different AAS exist depending upon the type of content. These two types are journal level altmetric and article level altmetric. [S1]

- **ARTICLE LEVEL ALTMETRIC SCORE**: Studies have found that the Altmetric score at the article level is not well linked with the citation-based metrics. Mendeley, being the highest influencer has got a score of 0.353. Altmetric score has a subtle relationship with the blogs, news and tweets etc. [S1]

- **JOURNAL LEVEL ALTMETRIC**: Journal level Altmetric show a stronger correlation with the traditional citation. All the co-relations have a significant score of $p<0.01$[S10].

If there is no co-relation between Altmetric and traditional citation, this indicates that there exist differences between scholarly and social importance [S8].

In previous paragraphs we have discussed digital libraries which were used to calculate the Altmetric Attention Score by the fetching of data. Another tool for calculating the Altmetric Score is the Altmetric Aggregator. It makes the library more attractive by compiling the statistical and logistical data into colourful doughnuts. Different colours represent different types of sources. Faculties which need to demonstrate their performance to their employees take advantage of Altmetric doughnut. Altmetric when joint with the digital library will serve as an efficient assessment tool of Altmetric Attention Score [S18].

Altmetric.com is a platform which automatically calculates the Altmetric score of an article or page of content. It's impossible to calculate the altmetric attention score manually, so the precise information regarding the calculation is not obtainable. This namesake company tracks the mentions by using the "PubMed ID", or a URL of mentioned work [S13].

3.3 What does altmetric score define

As per [S11], the Altmetric is not normalized so it does not contain any of the specific scales. Although it is also concluded that the scale of 0 shows that there is no attention gained by the article. The score of the Altmetric tells you in what context and rank you should put the referencing and set of data to. In other words, it gives you the authenticity of the set of data you have selected. The score shows how important is the set of data.

The score of the set of data under consideration varies from perspective to perspective for example if a set of data is of immense important for person A, it is not necessary that it would be of the same importance for person B. The importance of the data varies which the context as well. It depends on which perspective we are going to take data. In recent years, it was concluded that the fraud in the archiving and false referencing and citations being made have taken all over the referencing ecosystems. To avoid these, this score was introduced [S11]. Altmetric.com is a website which offers the users to analyse the score themselves. This score helps the author to predict the popularity of a certain set of data over the internet.

When it comes to scores, the question that may arise is what is a good score? A good score in Altmetric is not important at all. For instance, the score of a journal of science may have a higher score than a smaller journal. The difference of good magnitude in the journal does not mean that the second journal is of no importance or it is less important or popular than the science journal. Moreover, the score does not remain constant with time as there are several types of research made every day and the results or outcomes

may or may not change with the research [S11]. The information is only considered authentic at the time of publication of the paper. This is the reason the time limit of the publication is of immense importance when it comes to the sighting of the scholarly articles.

Another important thing that should be considered is that Altmetric is not a substitute for traditional citation method and the Altmetric attention score shows where and how the piece of information is shared or cited. For example, whether it is twitted about or it is being cited in some article etc. AAS is in the form of the primary rainbow colours. The colour shows attention gained by the quality or quantity of the data.

[S11] also asserted that this score is driven out by following the specific algorithm. The three major elements are used to measure the Altmetric attention scores mentioned above. Volume speaks up of how many times the article is referred. This helps to predict the popularity of the set of data. The second is the sources; this indicates the origin of the data; this helps the researcher to read the authenticity of the data. And the third is the authors which help the researcher to validate the piece of information. This overall effect of the three factors makes up a score which is used to validate the authenticity and the popularity of the piece of information.

Nonetheless, Altmetric allow the scientist to make a smart decision by showing the visibility of a topic off the Web, encouraging analysts to select the data on the Web. This makes the selected data more explicit and more accurate than the usual measurements in a faster way. In addition, providers offer analysts an advantage in terms of open access [S11].

[S18] discussed that Altmetric is a set of measures designed to determine the impact of computer-aided subsidies on the Web. Because researchers and specialists always share their content and are interested in the Internet, Altmetric is used by many researchers as an authentic marker. The altmetric is unique compared to the normal sign or reference technique. Altmetric is a unique marker type that contains several types of extended pointers that refer to insightful work. Each of these indications is part of the exercises performed by the different researchers and climate partners of the exam [S9]. Not only is Altmetric information enforced by downloads, perspectives and preferences via web-based network media, but this information is also considered to be old-metric data elements.

3.4 Key findings of research area

To sum up the findings from the existing literature the following Table 5 describes the key important findings of the research area done by researchers by evaluating and discussing the altmetrics as a research subject.

Table 5 Key findings in the research area by researchers

Findings	**Research correspondence**
Access to broader impact of research output	Bornmann, (2014)
Altmetrics makes a link of communication between scientific communities & society.	(Sugimoto et al., 2017)

Better and confident evaluation of research outputs for academic and higher education assessments.	Thelwall, (2014)
Combination of web-based indicators can complement the research dissemination also research evaluation.	Thelwall, (2013) and (Sugimoto et al., 2017)
Geographical bias in national and international perceptive.	Thelwall (2014) and Trueger et al., (2015)
Strong established network to explore social media platforms for continuous social mentions and interactions.	Fenner, (2013)
Altmetric provides broader understanding of impact indicators explain the diversity of impact indicators and analysis.	(Thelwall et al., 2013) and Barnes, (2015)
Research funders can easily evaluate the existing scholarly work for the evaluation of funding programs.	Haustein, (2016)
Altmetric attention score is dependent on sources and algorithm analysis which makes it limited and biased towards the actual indication of research impact.	Jan, & Zainab, (2018).
The relation between altmetric attention score and citation counts is weak, but it has a potential to complement the citation-based approach.	Baheti, & Bhargava, (2017) and Yang, & Dawson, (2018)
The altmetrics attention score and other related information of indicators is quick and yield in very less time as compared to traditional citation-based or peer reviewed approaches	Thelwall, Haustein, Larivière, & Sugimoto, (2013)

3.5 Opportunities and limitations of altmetrics

This sub chapter of this study is intended to discuss the opportunities and limitations of altmetrics in the light of information extracted and gathered form the selected studies. This section also directly addresses the second research question of this theses study.

3.6 Opportunities of altmetrics

Following table 6 list the key opportunities of altmetrics. The table is placed here to give the reader a quick depiction of extracted results in terms of altmetrics opportunities before reading the mentioned benefits in the subsequent extracted narrative of researchers about the overall benefits and opportunities by altmetrics.

Table 6 Key opportunities offered by the altmetrics

Opportunities	**Research Correspondence**
Instant indicators of impact	[S24], [S23], [S18], [S14]
Diversity of details as compared to traditional methods	[S5], [S7], [S10], [S12]
Article & author level metrics gives more immediate insights	[S16], [S14], [S13], [S12]
Supplements the existing impact measuring methods	[S18], [S14], [S13], [S24]
Promote and support the scholarly communication on web enabled platforms	[S18] [S14], [S12]

As per [S13], the biggest benefit and significance of Altmetric is its availability on any article with reference to the online importance and consideration it receives. Secondly, it is an efficient tool for the author to elucidate its article's impact. It has also got numerous potentials for academic institutes and publishers. Comparing with the traditional metrics, which had many limitations, Altmetric is given a broader spectrum for visualizing and determining the research impact.

The benefits of Altmetric are still not very clear for us. They are in the process of evolution and in the upcoming years, more benefits are sure to come. Radiologist should avail this opportunity as this will be a very successful tool in their research impact [S9]. Highly cited articles based on citation count can provide the qualitative information of research but lacks in providing the exact impact and attention received by the highly cited articles [S5] & [S1].

Altmetric can be possibly used in many aspects. That is why it is widely regarded by many researchers and scholars. For traditional citation method, there were limited options. It was only used for scientific research and was unable to meet the demands of government and other lending institutions. Government and funding institutions also want scholars to work on the social impacts. Here Altmetric serve for this purpose of government and funding institutions. Some major impacts of Altmetric are considered by the "Research Excellence Framework and the Higher Education Council for England (REFHEC)" where they want to promote this impact beyond academics. Popular web-based micro blogging system; Twitter is also a very famous source of Altmetric. All the data collected from Twitter is enumerated in the Snowball Metrics Recipe Book where they are used as a standard of indicators for other research evaluations.

[S9], [S10] stated that due to increases online interactions and web blogging, new data is constantly being collected online. By taking advantage of social platforms, researchers can easily get an insight into who is interested in their works. They can also get information about people's field of interests, their field of education and then use it as a

tool to extend their research work which meets the demands of the respective group of people.

Altmetric can also be used as filters. There are numerous data that is available online that needs to be filtered and sorted out when accessing. The main objective is to filter out the most relevant data for a researcher's work. Altmetric can determine the rating and review of any specific data available on the internet [S9].

There are several benefits of the Altmetric indicators in the field of science. They are an `alternative to the electromagnets used widely in the communication sector and OSH (occupational safety and health) [S10]. Altmetric helps to make sure that the research being made is associated with society. It also shows how the research is related to the society, the people, the government, public and the policymakers. This is the next level to the scholarly ecosystems which creates ease for the author as well as the reader to associate the research to daily life. Moreover, the Altmetric also provide a wide range of accuracy in the citations and the referencing. This type of referencing helps the reader to dig out the origin of the data that has been mentioned or cited in the research [S1].

According to [S11], the Altmetric also allows the researcher to make a wise choice as the Altmetric helps to allocate the degree of popularity of a certain topic prevailing over the internet, which helps the researcher to choose the information on the internet. These also make the information chose specific and more accurate in a faster way than that of the traditional metrics. Moreover, the providers provide the researchers with open access advantage which helps to cite data in an easier way than in the propriety database. For example, Research Gate has opened its services as open access research articles were more likely get more citation counts.

In addition to this, the Altmetric allow the usage counts and the number of citations been made on behalf of the research article. Every science-based web has offered the facility so that both the author and the researcher who is going to cite it would know whether the information that he is using is authentic or not. Moreover, it also shows how much the article has been read and how many times it has been downloaded. This ensures the author that his findings are been used [S11]. In the future when the altmetrics will be evolved enough and compatible with different platforms will surely make a difference. The adoption will be quick and handy.

As the [S23] suggested and concluded about the development and adoptability of altmetrics in his paper that the development and implementation of alternative metrics adaptability will be major step of improvement towards scholarship systems improvement of higher education, towards routing and implementing the research and research outputs towards societal requirements and also to benefit various groups and population around the world.

3.7 Limitations of altmetrics

In the following table 7 the key limitations of altmetrics are mentioned. The table is placed here to give the reader a quick depiction of extracted results in terms of altmetrics limitations before reading the mentioned limitation in the subsequent extracted narrative of researchers about the limitation.

Table 7: Key limitations of altmetrics

Limitations	**Research Correspondence**
Altmetrics are limited to web platforms only	[S1], [S3], [S12]
Altmetrics are still under development needs more time get mature and provide more details to impact score calculation	[S2], [S5], [S12], [S23]
The score generated by the altmetric can be gamified to promote specific research works	[S10], [S7], [S12]
Altmetric score calculation could be platform biased as score weights varied from source to source	[S16], [S12], [S1]
Limited to quantitative impact measurement but can't measure the qualitative information of disseminated work.	[S12], [S5], [S14], [S13]

[S20], stated that Along with several advantages Altmetric also have certain limitations associated with it which is exactly like the metrics which are citation-based. It should be kept in mind that attention instead of quality is measured by Altmetric. When on the internet work is mentioned or cited the nature of attention is not distinguished by both the alternative metrics and the traditional metrics even sometimes the work is mentioned or cited by the scholars for the purpose of criticism. By doing so instead of a positive impact a negative impact is generated hence many citations for the data of alternative metrics may occasionally be the positive feedback evidence.

Alternative metrics is thought to be a good and easy game. [S16], In the year 2013, a fake paper in this regard was created by the conductance of three types of research, through those researches certain activities were created and the paper was cited on the internet and the alternative metrics were generated. A danger for the alternative metrics was generated by those three types of research one of those dangers is that the alt-metrics might be boosted through fake attention. The altmetrics attention score of other related information indicators is quick and yield in very less time as compared to traditional citation-based or peer reviewed approaches [S3].

The previous studies done on the relationship between the metrics are based on citations which is an indication that the Altmetric is the future citation's early indicator. Or in simpler words, if any work on the internet is getting a lot of attention this could be the cause of the generation of several in print citations. Anyhow according to the studies those were conducted later lead to the production of ambiguous findings and cause the results

to become inconclusive [S14], [S15] in order to resolve these conflicting findings several more types of research needs to be conducted. Though altmetrics have been playing a significant role in the analysis of citation impact, but it does have some limitations and due to these limitations, it can only supplement the already existing metrics, but it cannot replace them completely [S3].

[S15] also mentioned that due to the openness of social media and internet to the general public at the different education levels, the difference can be generated by the difference in work. It is a common observation that more attention is given to the more common subjects whereas the least interested and least common subjects are given less attention. Like for instance the researchers conducted on the weight loss may result in the generation of more views on the internet pages as compared to the page of the noble researches physics pages. [S1] Despite the weaknesses, those are afore mentioned in this regards the alternative metrics tools are still viewed due to their availability and their value and are found useful in several different ways. The alternative metrics true nature is still not yet discovered and certain measure are taken nowadays in this discovery process.

The use of alternative metrics has been facing many criticisms for the evaluation of different researches. The validation lacking and the limitations of the data collection have been the focus of many researchers (Alternative Metrics) [S2], [S6]. On the other hand, the focus of the other author mainly believes that the alternative metrics cannot be considered as the impact indicators but more commonly called as the [S21]; [S9],[S12] The main reason behind this criticism is lack of the proper theoretical and the conceptual groundwork for the alternative metrics that could be the reason for the provision of an interpretative lens that helps in understanding the motivations behind the act of social media. An overview of the various alternatives metric's conceptualization, data collection limitations along with the literature are provided by an article by various platforms [S4].

As per [S17], [S18] "it is not clear today the research impact in the society's other areas in correspondence to science that should be measured". For the distinguishing procedure of the alternative metrics from the bibliometrics the Altmetric are considered as an important option for the assessment of the societal impact of research output as certain new public engagement methods are provided by it. [S20], [S18] also asserts that Altmetric can be defined as the term for the description of the metrics that are based on web for the publication impact along with certain impacts of the publication along with certain other scholarly materials by the use of the data from certain platform of wen enabled media. This also deals with the classification and the definition of the term Altmetric. Its benefits along with the disadvantages furthermore are discussed [S21].

As stated, [S16], [S15] Altmetric paper have been reviewed and this review raises the concept that the new indicator's development is based for the evaluation purpose on Web 2.0. Some of the limitations are briefly discussed in this study. The entire story cannot be unrevealed by the Altmetric, as it is mentioned above that the Altmetric cannot be considered as a replacement for instead of a complement to, things that helps in things including the metrics that are citation based or peer to peer review. Just like many other metrics that always exist a gaming potential. Any individual that has enough time for artificially inflating the alternative metrics for the research purposes. This is the main reason that the providers of Altmetric including PLOS and SSRN have taken certain measure for the identification and the correction of gaming.

The alternative metrics are generally thought to be a new concept and for its better understanding more and more research is required. Although there have been a lot of new learning on the procedure of sharing any research online. It can be concluded at the end that the interpretation and the use of alternative metrics should be done carefully [S22]. The altmetrics attention score of other related information indicators is quick and yield in very less time as compared to traditional citation-based or peer reviewed approaches [S3]. The reproduction of altmetrics data is impossible to obtain similar results. The data gathered from different platforms and web source can be changed or get removed permanently i.e. twitter tweets, LinkedIn mentions. The access to some of the data sources is also limited which makes the altmetric attention score a bit bias with respect to platform or sources dependency [S24].

4. Discussion

This chapter of the study is dedicated for discussion about the gathered results through the literature review. The aim of discussion is to answer the focused research questions of the study. The primary focus of this theses study was to explore and evaluate the altmetrics as an emerging platform for the measurement of research impact while complementing the traditional citation-based approaches. There are various benefits and limitation found and mentioned in this study, the most discussed and mentioned limitation of altmetric by other scholars is the adoption and reliability.

RQ1: What is behind the altmetrics attention score?

RQ2: What are the opportunities and limitations of altmetrics?

Altmetrics being a comprehensive tool for measuring the dissemination impact doesn't explain much about the qualitative measured data. The top view perception is sometimes appealing for a user to see the impact and reach of a research work, but the inside impact measuring, calculation is tricky and mysterious which doesn't state much about the altmetrics attention score calculation. Though, many indicators are vibrantly present on altmetrics platform to indicate the story of dissemination of research work, how it started through which platform its started to gain impact and how much attention or impact the research work has scored so far. For the altmetric score calculation the most important main aspects which helps to calculate the score includes the 'volume', 'sources' and 'authors' of articles plays an important role for the calculation of altmetric attention score. (Wright, 2014)

The primary question for a novice user after using the altmetric would be the how the whole attention for a shared or read an article over social media attains the attention. What sub factors related to altmetrics attention score improves the attention score to seek the higher attention or making a study a bit more prominent over the web or social media platforms. As the primary target of this study is to evaluate the altmetric as impact quantification tool for the determination research impact over web platforms, but the evaluation of the altmetrics is not possible without knowing the AAS and its calculation for quantitative collection of the attention of a specific research article or output shared over the web, especially on social media platforms including Twitter. Conclusively, from the various research articles and scholarly studies indicates the limitations of the automatic attention score being limited in many aspects to reveal the received impact or attention by a research article (Piwowar, 2013). Now, as the alternative metrics approach is being widely used not just for the research impact measurement over the web, but the scope of its implications is getting wider.

Research communities are using altmetrics as a reliable metric of evaluation for research funding application, the usage is increasing day by day as the emerging altmetrics approach is becoming more evident as a reliable source of research dissemination impact. What altmetrics promised to present as a research impact is more promising and exploratory as compared to traditional citation-based metrics. Piwowar, (2013) describe the change in scholarly communication as a primary reason for the adaptability of altmetrics in research communities as scholarly communication is becoming more evident over the web (Sud, & Thelwall, 2014). Mike Thelwall in his conclusive study about the

evaluation of altmetrics states the reason of altmetrics rise as extensive and growing practise of Twitter and other social media platforms by researcher in the process of scholar communication over web.

The primary research question of this intended study is also focused to evaluate the altmetrics with respect to its numerical perspectives like what exactly the AAS states about the disseminated research work? Do the numbers associated with AAS makes some sense to a novice person who doesn't know much about altmetrics? In almost every discipline of science the importance and consider ability of altmetric is growing to measure the early impact of disseminated research work Piwowar (2013). One another strong argument is about the transformation of scholarly communication itself, the way altmetrics and its importance is emerging it will surely transform the usual way of scholarly communication and evidence to this happening can be observed over the web especially on web enabled communication platforms.

Since the advent of altmetrics in 2010 the development rate of growth and acceptability increase dramatically in scientific communities (Piwowar, 2013). The emergence of altmetrics benefited the researchers in many ways and the its quite evident that representation or dissemination of research work is not just limited to traditional citation-based approaches. The relation of numerical data and its presentation in form altmetric attention score and other indicators that a user can easily perceive the ranking or an idea about the popularity scoring of the disseminated research work. The gap filled by altmetric in terms of mentions and other strong indicators such as social media activity, demographics, and timeline stats related to shared work are some key aspects which were missing earlier. Thelwall and colleagues (2013) conclusively states that the majorly the tweets, Facebook posts, blog mentions, and new mentions are the top altmetrics indicators which directly associate the AAS with citation count or with the possible future citations of the mentioned research output.

In the persistent limitation of altmetrics the most commonly discussed limitation is the rapid growth of article as the article volume increases the fresher articles always takes precedence over the old articles, which makes it difficult for the older articles to resurface again with higher article score (Trueger et al., 2015). In global perspective the altmetrics tend to show another limitation regarding the limited or very restricted usage of social media platforms in different parts of the world due to social and political issues. In developing countries, the limited IT infrastructure and internet resources are also a reason where altmetrics can surely miss the chance to measure the impact in global perspective. (Thelwall, 2014; Trueger et al., 2015).

The credibility of altmetric attention score is another challenge, the altmetrics attention score also weighs the authors or mentioners of posts or mentions, but it seems very difficult to assure the credibility of the mentioner or commentator on the web. Another major disadvantage in AAS calculation is the total omission of citation counts recorded by different web site services like CiteULike and Mendely. This exclusion of citations from the score weights and calculation limits the altmetric attention score from complementing the traditional citation-based impact of disseminated research outputs. The association between the altmetrics and citation counts is significant but, in some cases, its weak, but it makes sense in terms of relating the citations with AAS. Probably, with the growth of article volume and sources the relationship between AAS and article citations can be improved with the passage of time. This will also increase rate of the

adaption of alternative metrics in I wider perspectives and for measuring the impact of research dissemination over the web.

5. Conclusions

This final chapter of this thesis study is to elaborate the concluding remarks about the study findings. The aimed of this study was to evaluate and explore the altmetrics in the light of existing literature and knowledge about the alternative metrics and altmetrics being an individual commercial platform. The study followed a literature review approach to record and report the narrative of scholars about alternative metric and altmetrics platform. By following the literature review approach the study targeted 24 articles relevant to the research question defined to set the scope of this study. The articles were retrieved from four different research databases including Google Scholar, IEEE Xplore, Web of Science and ScienceDirect.

By following the literature review approach the collected research articles were thoroughly analysed and examined to collect and report the most relevant knowledge to construct the base for the evaluation and opportunities and limitations of altmetrics and altmetric.com as a commercial platform implemented on the base of alternative metrics. It's evident from the results that for the true research impact measurements dependence on a single metrics is neither enough nor reliable. For both qualitative and quantitative measurements of research dissemination impact combination of metrics will be always involved. The article level metrics are more reliable as compared to author level metrics. Mostly, article level metrics are widely adopted and evident for the measurement of disseminated research outputs. Thus, the significance of altmetrics is raising as the focus of altmetrics is more towards articles mentioned over the web and social media platforms.

Previous studies and analysis performed on altmetrics data by scholars suggests that altmetric score is a good indicator of possible future citations and attention a research work can accumulate. Though, the direct relation with citations and altmetric score is not easy to explain. The significance of altmetric attention score can't be ignored in terms of indicators and future citations. The altmetric attentions score can supplement the existing approaches to improve further in terms of relations and impact but it cannot completely replace them. Altmetric related articles have been reviewed and this review raises the concept that the new indicator's development is based for the evaluation purpose on Web 2.0. Also, there are number of limits that might be linked with the use of Altmetric as platform for indicators. Some of the limitations are briefly discussed in this study. The entire story cannot be unrevealed by the Altmetric, as it is mentioned above that the Altmetric cannot be considered as a replacement for instead of a complement to, things that helps in things including the metrics that are citation based or peer to peer review.

The findings of this study provide a through overview of alternative metrics and its growing important with respect to scholarly communication and research impact over the web. The findings are concluded from selected set of articles which are already mentioned in the findings section of this study. The set of primary studies addressed the scope and analysis has been reported with respect to altmetrics attention score calculation and its perspectives for the reader. Also, the limitations and opportunities of altmetrics identified to put emphasis for the adoption and acceptability of altmetrics as an alternative metric approach to traditional citation-based approach or webometrics.

5.1 Limits and validity

By following the literature review approach and targeting specific research databases the study is already limited with respect to resources. Moreover, the topic is also narrowed to only target the altmetrics attention score and its opportunities and limitations for researchers and readers. The study also only focused on most recent articles published in the last five years, extended period for extensive literature review and data collection would be ideal for a broader study. Also, the comprehensive research questions can be designed to target the evaluation alternative metrics comprehensively. To perform the comprehensive literature review further human resources will be required to extract the more related and extensive knowledge. Therefore, this study could be a base for a further extensive study with a focus to perform on broader lengths.

5.2 Further work

For the purpose of further research, the topic can be enhanced to dig out further about the important and emerging role of altmetrics. As the technology behind altmetrics is continuously evolving and getting batter the future research work in the domain and with related broader topic can be carried out to produce more concrete knowledge foundation. The existing knowledge of the domain is scattered in wider range which apparently is a hurdle to stay centric for the evaluation of altmetrics. There is a lack of comprehensive literature review for only the evaluation of altmetrics regarding the benefits and limitations of this emerging platform.

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Appendix A. Structure of data collection & literature review process

1. Background

2. Research questions

3. Search strategy

3.1 Keyword combination search queries

b. Searched in only opted databases

4. Study selection criteria

a. Inclusion criteria

b. Exclusion criteria

5. Final Studies selection procedure

6. Study quality assessment

7. Duplicates removal

Appendix B. List of main studies

Authors	Study Title	Reference No.
Trueger, N. S., Thoma, B., Hsu, C. H., Sullivan, D., Peters, L., & Lin, M. (2015)	The altmetric score: a new measure for article-level dissemination and impact.	[S1]
Barnes, C. (2015)	The use of altmetrics as a tool for measuring research impact. Australian Academic & Research Libraries	[S2]
Thelwall, M., Haustein, S., Larivière, V., & Sugimoto, C. R. (2013)	Do altmetrics work? Twitter and ten other social web services	[S3]
Zahedi, Z., Costas, R., & Wouters, P. (2014)	How well developed are altmetrics? A cross-disciplinary analysis of the presence of 'alternative metrics' in scientific publications. Scientometrics,	[S4]
Sud, P., & Thelwall, M. (2014)	Evaluating altmetrics. Scientometrics	[S5]
Fenner, M. (2014)	Altmetrics and other novel measures for scientific impact. In Opening science	[S6]
Elmore, S. A. (2018)	The Altmetric Attention Score: What Does It Mean and Why Should I Care?	[S7]
Alhoori, H., & Furuta, R. (2014).	Do altmetrics follow the crowd or does the crowd follow altmetrics?	[S8]
Sugimoto, C. R., Work, S., Larivière, V., & Haustein, S. (2017)	Scholarly use of social media and altmetrics: A review of the literature	[S9]
Witold, S., & Ewa, K. (2018)	What kind of impact is more important? role of altmetrics indicators	[S10]

Jan, R., & Zainab, T. (2018).	The impact story of retracted articles altmetric it!	[S11]
Haustein, S. (2016)	Grand challenges in altmetrics: Heterogeneity, data quality and dependencies	[S12]
Baheti, A. D., & Bhargava, P. (2017).	Altmetrics: A measure of social attention toward scientific research.	[S13]
Bornmann, L. (2014).	Do altmetrics point to the broader impact of research? an overview of benefits and disadvantages of altmetrics.	[S14]
Bornmann, L. (2015)	Alternative metrics in scientometrics: A meta-analysis of research into three altmetrics.	[S15]
Liu, J., & Adie, E. (2013).	Five challenges in altmetrics: A toolmaker's perspective.	[S16]
Melero, R. (2015)	Altmetrics–a complement to conventional metrics.	[S17]
Yang, S. Q., & Dawson, P. H. (2018)	Altmetrics and Their Potential as an Assessment Tool for Digital Libraries	[S18]
Mukherjee, B., Subotić, S., & Chaubey, A. K. (2018).	And now for something completely different: the congruence of the Altmetric Attention Score's structure between different article groups.	[S19]
López-Cózar, N. Robinson-García, and D. Torres-Salinas. (2014)	Manipulating Google Scholar citations and Google Scholar metrics: Simple, easy and tempting.	[S20]
Crotty, D. (2014)	Altmetric: Finding meaningful needles in the data haystack	[S21]
Torres-Salinas, D., Cabezas-Clavijo, Á.,& Jiménez-Contreras, E. (2013)	Altmetric: New indicators for scientific communication in web 2.0	[S22]

Alperin, J. P. (2013)	Ask not what altmetrics can do for you, but what altmetrics can do for developing countries	[S23]
Tunger, D., Clermont, M., & Meier, A. (2018)	Altmetrics: State of the Art and a Look into the Future	[S24]